day 24

Product Rule proof (& useful technique)

$$\lim_{h\to 0} \frac{f(x+h)g(x+h) - f(x)g(x)}{h} =$$

$$\lim_{h\to 0} \frac{f(x+h)g(x+h) - f(x)g(x+h) + f(x)g(x+h) - f(x)g(x)}{h}$$

$$= \lim_{h\to 0} \frac{f(x+h)g(x+h) - f(x)g(x+h)}{h} + \lim_{h\to 0} \frac{f(x)g(x+h) - f(x)g(x)}{h}$$

$$= \lim_{h\to 0} g(x+h)\left[\frac{f(x+h) - f(x)}{h}\right] + \lim_{h\to 0} f(x)\left[\frac{g(x+h) - g(x)}{h}\right]$$

$$= g(x)f'(x) + f(x)g'(x)$$

So $\frac{d}{dx}(f(x)g(x)) = f'(x)g(x) + f(x)g'(x)$

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Play

$$\frac{d}{dx}\left(x^2 \cdot x\right) = \frac{d}{dx}\left(x^2\right) \cdot x + x^2 \frac{d}{dx}(x)$$

$$= 2x^2 + x^2 = 3x^2$$

$$\frac{d}{dx}\left(x^3\right) = 3x^2$$

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3.3/39) Let $f(x) = x^2 - 6x + 5$

a) Find ... slope is 0

Find the values of x for which the slope of the curve $y = f(x)$ is 0

direct object

$f'(x) = 2x - 6 = 2(x-3)$

$f'(x) = 0 \Rightarrow x = +3$

done :)

day 24

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49/ a) $\frac{d}{dx}(10^5) = 5\cdot 10^4$ FALSE $\frac{d}{dx}(c) = 0$

$5\cdot 10^4$ however, this is not the same as $50^4$

b) the slope of a line tangent to $f(x) = e^x$ is Never 0.

true, because $\frac{d}{dx}(e^x) = e^x$, and that is never 0

c) $\frac{d}{dx}(e^3) = e^3$ false, because $e^3$ is just a number

$\frac{d}{dx}(e^{3x}) = \frac{d}{dx}(e^x \cdot e^x \cdot e^x) =$ use product rule

d) $\frac{d}{dx}(e^x) = xe^{x-1}$ FALSE. don't be an idiot,

e) $\frac{d^n}{dx^n}(5x^3+2x+5) = 0$, for any $n \geq 3$ false

[I could make it $n \geq 4$..]

$\frac{d}{dx}(5x^3+2x+5) = 15x^2+2$

$\frac{d^2}{dx^2}(5x^3+2x+5) = \frac{d}{dx}(15x^2+2) = 30x$

$\frac{d^3}{dx^3}(5x^3+2x+5) = \frac{d^2}{dx^2}(15x^2+2) = \frac{d}{dx}(30x) = 30$

day 24

3.4 /6 show 2 ways to differentiate

$$f(x) = (x-3)(x^2+4)$$

i) $(x-3)(x^2+4) = x^3 - 3x^2 + 4x - 12$

$$\frac{d}{dx}(x^3 - 3x^2 + 4x - 12) = 3x^2 - 6x + 4$$

ii) $\frac{d}{dx}\left[(x-3)(x^2+4)\right] = \frac{d}{dx}(x-3)\,(x^2+4) + (x-3)\frac{d}{dx}(x^2+4)$

$$= (1)(x^2+4) + (x-3)(2x)$$

$$= x^2 + 4 + (2x^2 - 6x) = 3x^2 - 6x + 4$$

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3.4/5) $\frac{d}{dx}\left(e^{kx}\right) = ke^{kx}$

what values of $k$?

3.4/4 2 ways to differentiate $f(x) = \frac{1}{x^{10}}$

i) $\frac{1}{x^{10}} = x^{-10}$. Power Rule: $\frac{d}{dx}\left(x^{-10}\right) = -10x^{-10-1}$

$= -10x^{-11}$

ii) Quotient Rule: $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$

so: $\frac{d}{dx}\left(\frac{1}{x^{10}}\right) = \frac{\frac{d}{dx}(1)\cdot x^{10} - (1)\frac{d}{dx}\left(x^{10}\right)}{\left(x^{10}\right)^2}$

$= \frac{0 \cdot x^{10} - 10x^9}{x^{20}} = \frac{-10}{x^{11}}$